PREFACE

During my 15 years at the university of Rostock, during which I became a specialist in pathology before adding a specialization in gynecology and obstetrics, much of my work focused on early detection of cancer, and its treatment. This early phase of my career determined what became over 50 years of academic and practical work on the early detection of cancer, in particular with colposcopy on the basis of morphological studies.

The change from a university with a scientific agenda to a private practice with a dysplasia-clinic and my own cytological laboratory inevitably led to my membership in the gynecological society "Cervix Uteri" which, over time, evolved to becoming the "AGCPC" (German abbreviation for the society for colposcopy and pathology of the cervix).

Over 20 years, I was vice president of this society. In my role, before and after the fall of the wall, it was of particular interest to me to establish contact with the colleagues in East Germany and other countries of the former Soviet bloc, and to invite them to our conferences.

During my career, I was fortunate to have had the opportunity to work together with one of the most renowned German manufacturers of colposcopes, the company Leisegang in Berlin. New devices and techniques for diagnostics and documentation were tested and evaluated. The results were immediately applied in training and education, both nationally and internationally. As a basis of training in colpsocopy, the documentation of findings were continuously optimised via dia-slide-, Polaroid-, and video-technology. Ultimately, this led to the modern LED technology and digital, telematic usage through information technology. Important to highlight in this context is the contribution towards optimising stereoscopic photography because of its significance in the evaluation of colposcopic findings, shown in three-dimensional pictures.

In a globally connected, digital world, e-learning and tele-teaching has become an ideal basis for conducting lectures and conveying knowledge, as I have found out myself when becoming engaged in developing countries.

In this book, the teaching material on colpsocopy that I have accumulated and used over many years has now been didactically structured in mono- and stereoscopic teaching series, according to the current classification and nomenclature. It is suitable for both practical work as well as for teaching and training.

This book on colposcopy was adressed directly at doctors. Indirectly, however, it is targeted at women who need to know that a comprehensive, yearly, preventive and/or curative colposcopy can represent a substantial benefit to their health!

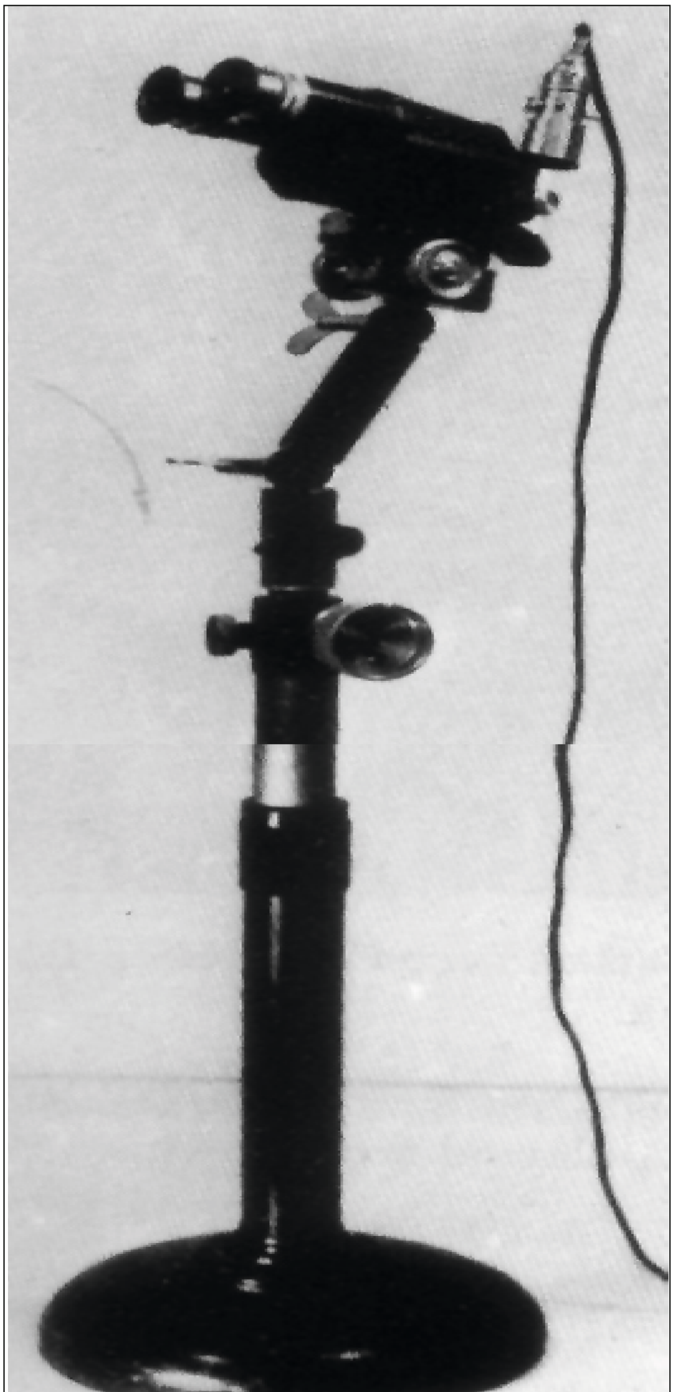


Fig. 1: First Colposcope – Leitz/Germany

DEVELOPMENT OF COLPOSCOPY AND COLPO-PHOTOGRAPHY

Earlier than in gynecology, in the field of dermatology optical tools were used to investigate surface areas (here: the skin). Already at the end of the 19th century, the company Zeiss constructed a binocular microscope with which plastic pictures were taken (13). In 1920, J. Saphier published his light-microscopic work and created the term "dermatoscopy" (40).

Also in the 1920s, two extraordinary scientists worked on the early detection of the globally leading cervical cancer: in the USA, George Papanicolaou's research looked at the cell smear of the vagina in order to arrive at a useable test. After many years of further work and the use of special staining the internationally accepted Pap-smear for cervical screening emerged.

At the same time, German gynecologist H. Hinselmann worked on an optimisation of the optical diagnostics of cervical cancer. He looked for small and easy-to-treat cancer with a "Präparierlupe" (lens) of the company Leitz (fig 1). In 1925, he published "Improvement in the Inspection of the Vulva, Vagina and Portio" (20), and called his method "colposcopy". This term had initally been formed only for the inspection of the genitals with a magnifying lens, sub-categorised under "micro-inspection" or "Lupenmikroskopie". Soon thereafter, Hinselmann introduced the use of acetic acid (initally 2%) in order to move aside "Schleim" (mucus) (21, 22). Following on from that, Schiller applied the iodine test. Both methods were termed "expanded colposcopy".

In the meantime, the iodine test, now with a 3% and 5% solution, became an integral part of a thorough colposcopic examination, and started to play the key role in the so-called differential colposcopy (s. in later chapters). The iodine test also has an important role to play in certain circumstances, and hence is recommended (strongly suggested as standard) by many authors on the subject.

In order to immediately remove the brownish colour, a 2% sodium-bisulfite-solution in 2% acetic acid was recommended (39). In later years, the toluidine-blue-solution was added (Collins) in which a 1% toluidine-blue-solution is applied as "Kernvitalfärbung" (nuclear vital staining). This test can be particularly helpful with lesions at the vulva.

The use of colposcopy on various organs had by then led to different, specific terminology. As a result, in some instances etymological mixes of Latin and Greek emerged, partly with the same meaning (Colposcopy – Vaginoscopy), partly linguistically incorrect (Vulvoscopy instead of Aidioioscopy, Peniscopy instead of Peoscopy, and Mamilloscopy instead of Theloscopy) (fig 2).

In the first 20 years, colposcopic findings were first captured in drawings and presented in "Moulagen". The first useful photos of the portio were presented in 1938 by Galloway (15). In Germany, in 1944, Treite published in bis book (70) pictures which had been taken with a modified operating cystoscope.

Application of the Colposcope

Cervix, Vagina	**Colposcopy, Vaginoscopy**
Vulva	**Vulvoscopy (Aidoioscopy)**
Penis	**Peniscopy (Peoscopy)**
Anus	**Anoscopy**
Mamilla	**Mamilloscopy (Theloscopy)**

Fig. 2: Organ colposcopies

In Switzerland, it was Wespi, in particular, who focused on the use of colpo-photography (31, 72, 73, 74).

With the further development of colposcopes came improvements of photographic picture documentation. Excellent black and white pictures (14, 46) and then colour pictures in academic books are testimony to this (3a, 3b, 3c, 4, 9, 10, 17, 23, 29, 32, 51, 67).

Fig. 3: Zeiss-Colposcope

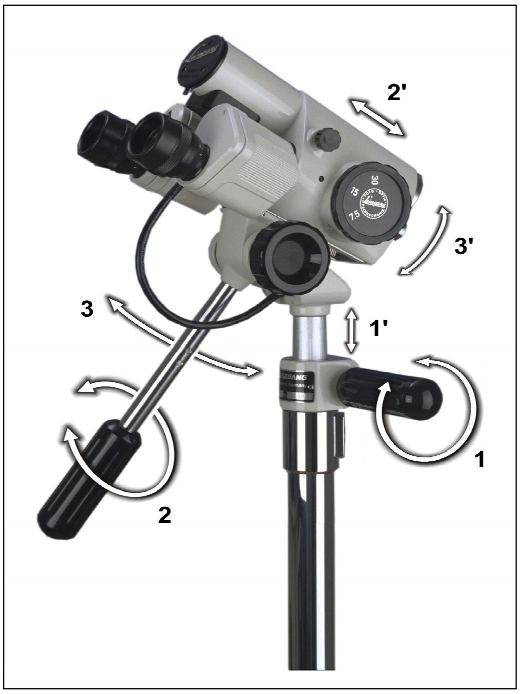


Fig. 4: Leisegang-Colposcope

In Germany, the companies Zeiss (fig 3) and Leisegang (fig 4) were leaders in the manufacturing of colposcopes. An adjustment of these tools to ergonomic and modern demands took place permamently. At first, a green filter was added, as suggested by Kraatz (24), in order to detect blood vessels more clearly. Then, adjustments to height, sharpness and angle were created so as to allow an exact positioning to the millimeter. A magnification adjustment in binocular tools of mostly 4 to 40 times led to stereoscopic magnification, covering the span between the visibility with the naked eye, and with a microscope (fig 5, 6).

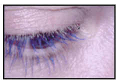


Fig. 5: Eye – without magnification

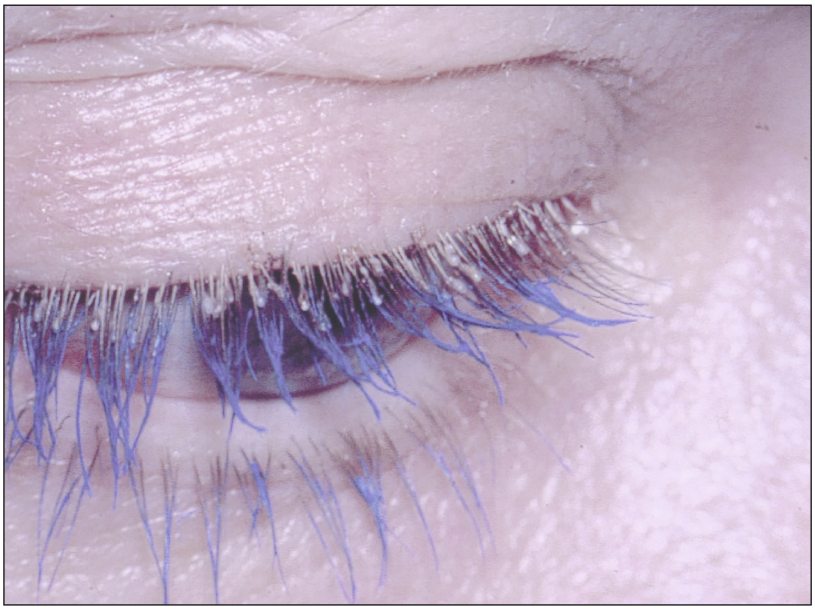


Fig. 6: Eye – after colposcopic magnification. Only now are nits visible.

For the documentation of colposcopic findings, simple renderings of the portio, for the sake of marking the findings, were often applied and taught (fig 7). An optimal report of findings, however, was only achieved later through photo-documentation. This was further developed through optimisation of the colour temperature (Kelvin) and colour representation (CRI, Colour Rendering Index): it evolved from a "warm" halogen picture to an energy-saving, whitish LED-picture. LED-lamps also had the added benefit of a longer life expectancy (fig 8). Modern lamps by the company Leisegang, for example, have a Kelvin-Index of 5600 and an ideal CRI of 92 (fig 10) !

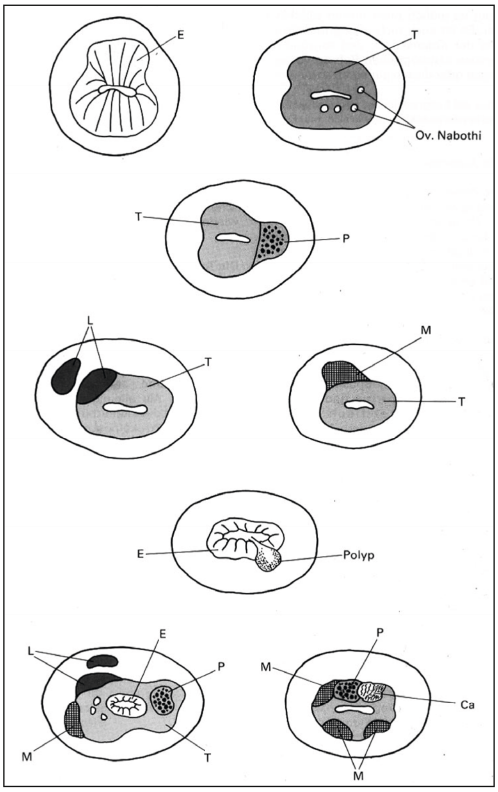


Fig. 7: Sketches of the Portio with abbreviation of the findings

Fig. 8: Atmos-Colposcope

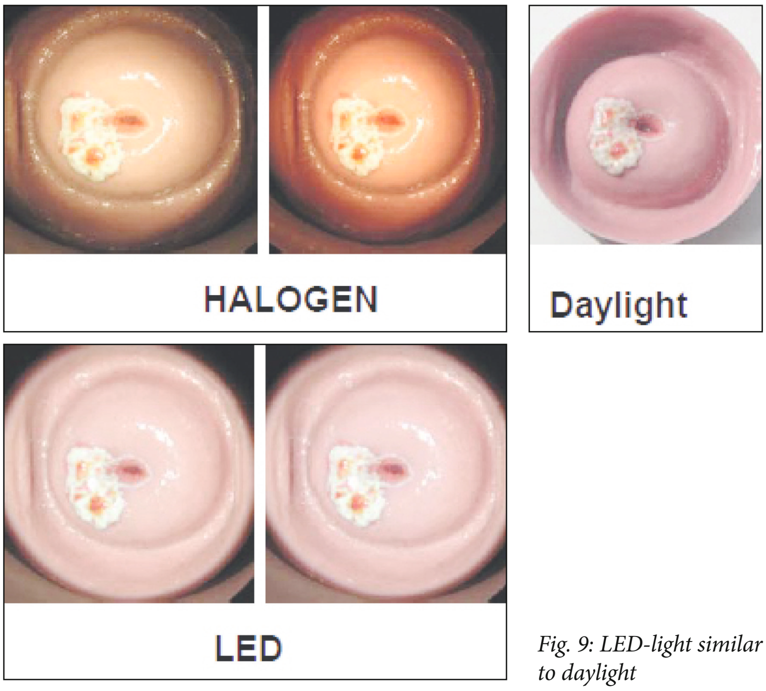


Fig. 9: LED-light similar to daylight

Fig. 10: Modern Leisegang-Colposcope

However, this development led to a different colour experience, in particular of photos of the portio. These pictures now contained a blue LED colour instead of a warm, reddish colour of halogen (fig 10). It is for that reason that LED-colposcopes no longer use green filters ! (59)

After the initial production of monoscopic colposcopes with photographic capability, binocular stereo colposcopes soon became the order of the day, with the capability of dia-slide- , Polaroid-, video- and ste-

Fig. 11: Workstation company Leisegang/Germany

reo-photography. Modern colposcopes have a camera for photography and video, and nowadays are linked to a workstation where the material can be stored, organised and documented (fig 11).

Despite the competing cytology with the Pap-smear (papanicolaou, 1943), this technology led to a substantial improvement in colposcopic diagnostics and in teaching. 3-D capability of the colposcope added to this improvement. Already in 1952 Ganse (14a) demonstrated his progress in the stereoscopic colposcopies-photography. In Switzerland,

Fig. 12: Analogue Dia-Photographs

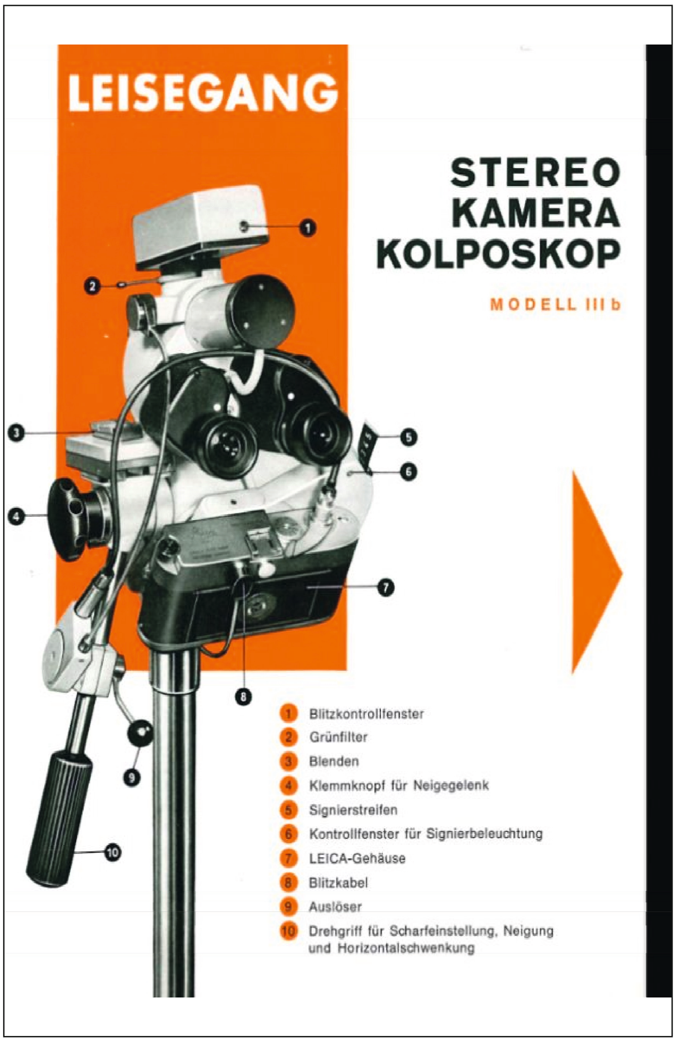


Fig. 13: Stereo-Photo-Colposcope IIIb – Leisegang

the renowned gynecologist Dr. Wespi (1954) (74) showed his stereo-colpo-photography at a conference for the first time.

German gynecologists Dr H.-K. Bauer (Wiesbaden) and Dr. St. Seidl (Hamburg), for many years in their respective private practices, carried out slide photography (fig 12), and photo-documentation with a stereo-photo-colposcope by the company Leisegang (fig 13). They also used this colposcope for their teaching in colposcopy.

Through such documentation, arriving at findings by visual examination became realistic, even for relative newcomers to this method. Even though it appears to be a difficult-to-learn method, the improvements in technology were a key reason for the expanded use of the colposcope, as it requires – next to some basic understanding of histo-pathology – good picture material, which now became more easily available.


Fig. 14: Video-Colposcopy

A further improvement was achieved by the dynamic representation of findings via video-colposcopy (fig 14). This created the ability, via a screen, to carry out targeted biopsies and operations, whilst looking on.

The current highlight are the innovations in tele-medicine! With telematics, a successful combination of communication and information was created, allowing for teleconsultation and direct application in diagnostics and teaching as a result (41, 59). With digitalisation and the optimisation of colpo-photography, the teaching, and in particular, the evaluation of colposcopic findings was substantially simplified. However, a further improvement in 3-D is required! This is technologically feasible, but it is not very common yet. Currently, Argentine gynecologist Coppolillo is carrying out 3-D depictions of colposcopic findings with the use of a special software (11, 12, 59).

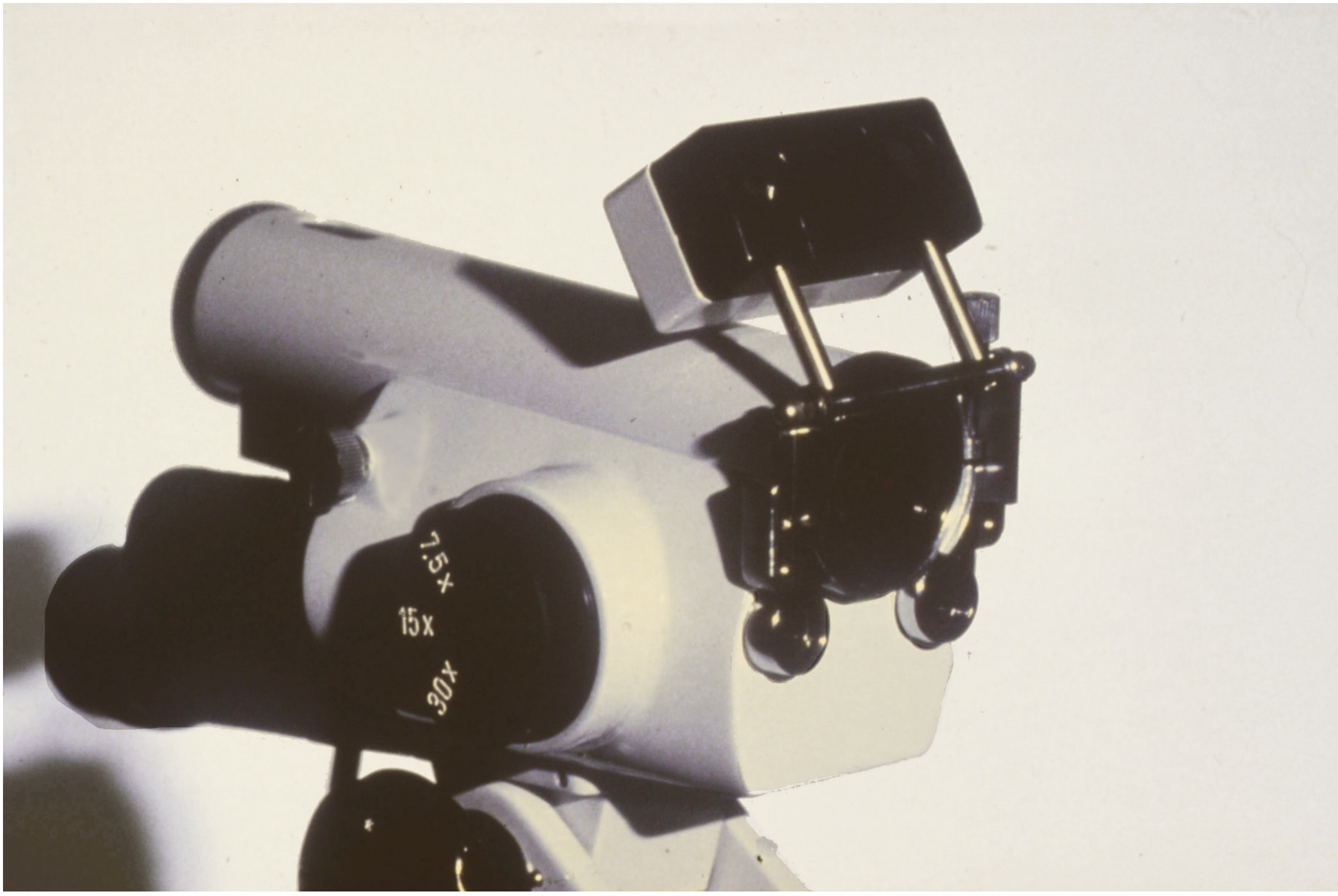
The mono- and stereoscopic picture series by Dr Seidl promote tele-colposcopy as a teaching method of the future, benefitting, in particular, developing countries. This method fulfils the demand for a teaching and training method on the basis of self-learning (66)!

Further, Dr Seidl in 2015 created the "Hamburg Colposocopy Forum", an open-source platform (under www.ipathnetwork.org) for those interested in colposcopy (60). In this forum, contributions in text and/or pictures as well as interesting or unusual findings are shared and discussed. Also, this forum allows for a discussion on the significance and value of colpscopy in general.

A further advancement in web-based teaching was achieved by CampusMedicus (One World Medical Network, 44). With a special soft-and hardware, a synchronised telescopic live communication between the examining doctor and an observing expert can be set up. This allows for diagnostic and therapeutic measures to be jointly agreed upon and monitored, even over quite some distance.

In addition, there is the possibility for asynchronised telescopy, with the storing of data and pictures on a computer. By these means, findings can be arrived at , shared and discussed globally, according to the relevant time zones.

Currently, however, the implementation of this modern form of telescopy lacks funding, and, as a result, its implementation is somewhat slow. Also, in developing countries there is often a lack of conviction amongst ministries and doctors with regard to the benefits of tele-pathology. There, cancer screening is often solely based on VIA (macro-scopic diagnostics by the Acetic-acid test), and only rarely does colposcopy exist (44).



Engblick-Vorsatz (Leisegang/Berlin): Special attachment for colposcopical examination in Childhood and Adolescence

WHAT IS COLPOSCOPY ?

Colposcopy is a special visual, optical diagnostic method. It serves as an indicator for malfunctions, inflammations, skin alterations and, in particular, for pre-malign and malign lesions in the genital area.

Colposcopy is an integral part of a gynecological examination! An examination without colposcopy renders it incomplete.

Colposcopy is no replacement for histology! An experienced colposcopist may frequently, however, predict a likely diagnosis of the underlying problem, and consequently determine the procedure to be followed.

Colposcopy is a very subjective diagnostic method, requiring a high degree of experience. Doctors who see patients regularly in their general or specialised practices, will particularly benefit from this method. Arriving more easily at a safe assessment of findings.

Significance and role of colposcopy

In the last 10 to 20 years, the appreciation of colposcopy has significantly increased globally. This on the one hand due to the improvement of the colposcope as a physical tool for examination. On the other hand, it is also due to the findings with regard to the Humane Papilloma Virus (HPV) and their diagnostic characteristics. The binocular lens magnification of high-quality colposcopes, along with additional colour tests (acetic acid, iodine, toluidine blue) lead to a heightened security of the primary diagnosis. With regard to its reliability, it stands every comparison with other, good diagnostic methods (26, 27).

Results of simultaneous use of Cytology and Colposopy (after Bajardi)	
Preclinical carcinomata	838
Detected by Cytology	729 = 87,0 %
Colposcopy	663 = 79,1 %
Combination	828 = 98,8 %

Fig. 15: Bajardi

Colposcopy and cyto-diagnostics have a positive effect on one another. They complement each other in terms of the accuracy of the final diagnosis (fig 15). Colposcopy has a lower specificity than cyto-diagnostics, but it has a higher sensitivity!

The interventional forms of colposcopy with targeted biopsy (s. Target Biopsy) and therapeutic interventions from a colposcopic viewpoint have achieved a high degree of international recognition.

Colposcopy has become an enormous addition to the repertoire of a gynecologist in terms of its various applications and its possible insights. Unfortunately, in 1971 in the Federal Republic of Germany, this method was not

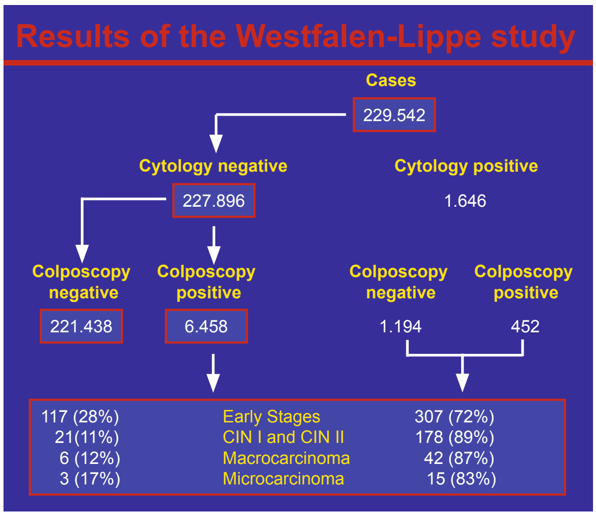


Fig. 16: Results of the Westfalen-Lippe study

included into the programme for the early detection of cancer! As former tests of the early detection programme in East Germany (German Democratic Republic) at the time indicated, colposcopy could have played a significant role in early diagnostics of cancer (37).

Furthermore , already in the 1950s, the centralistic health system of East Germany set up "Geschwulstberatungsstellen" (tumor-consultancy-centres) in all districts, equipped with colposcopes from Jena. These "Beratungsstellen" (consultancy centres) were staffed with trained "Fürsorgerinnen" (nurses). They had the logistical task to call in women for gynaecological examinations with colposcopy and cell-taking, and then to report results, via their district, to Berlin. They themselves never found out about the results but were, every now and then, awarded medals and prizes for their work! (65).

In West Germany, in the early 1980s, Beller's "Westfalen-Lippe study" with the concurrent use of colposcopy and cytology proved that colposcopy adds important additional insights, even in cases of negative cytology (fig. 16) (4). These results, however, did to align with the strategy of the general practitioners who wanted their share of cancer screening at all cost!

Still, there was a severe set-back when, for political reasons, the "Gebührenziffer" (fee code) for performed colposcopies was cancelled altogether. The fight for the fundamental recognition of colposcopy in Germany was nevertheless continued in the scientific society of the AGCPC, in conjunction with the European Society for Colpsocopy (EFC). In certified basic and advanced courses, some of which extended over several days, the foundations for obtaining a colposcopy diploma were created. From there, interested participants were able to seek acknowledgment of a dysplasia practice or unit (38).

The successes of the AGCPC (Arbeitsgemeinschaft für Zervixpathologie und Kolposkopie) and the overwhelming response to our constantly over-subscribed and improved courses led to a substantial change in the evaluation of colposcopy in the political arena: the scandalous elimination from the claim process was stopped after over 20 years! At the beginning of 2020, the Kassenärztliche Bundesvereinigung (KBV) (National Association of Statutory Health Insurance Physician) decided to re-introduce colposcopy as "Abklärungs (clarification) colposcopy as part of a change in the guidelines for the early detection of cancer" (2).

However, this applies only for colpocopies performed as part of early cancer detection.

A fundamental recognition also for clinical colposcopies, as demanded by the author for years, is still elusive!